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BIRMINGHAM.

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The imperious demands on man power which the military situation made in 1918, coupled with the further appropriation of productive resources for war purposes, could only be met by facing heavy additional sacrifices of Great Britain's regular trade. Birmingham and district bore their full share in the drastic curtailments that were effected. There was no industrial area in the country whose normal currents of trade were so completely reversed. The numerous metal-working industries grouped about the Staffordshire iron and coal fields were, without exception, able to render valuable service in swelling the output of munitions; and other branches of manufacture, such as those pertaining to leather goods, glass, pottery, carpets, and woodworking, all contributed their complements, with the result that the greater proportion of the output of the district was diverted from the civil trade to the State. Government control was further extended, and in the case of businesses not technicallycontrolled, traders ceased to be their own masters, inasmuch as they had no free market in which to buy or sell. They were only allowed material for their civil trade on the condition that they did a stipulated proportion of Government work, and if they were not for any reason putting their resources to the best use, the authorities had power to take possession of their plant and utilize it as they chose.

Effect of War on Improvement of Works.

Many manufacturers in the district were able to devote themselves very fully to war work without radical reorganization. For them it amounted, in effect, to little more than a change of customers. But where adaptations were necessary private traders were active in carrying them out. Apart from the patriotic impulse, there was a powerful spur to enterprise in the circumstances which arose out of the rapid development of war industries under the direct initiative of the Ministry of Munitions. Contracts were by no means so easy to obtain as they had been formerly. Prices were much more stringently curtailed, and ill-equipped and inefficiently conducted establishments were placed at a hopeless disadvantage. There were the strongest inducements, therefore, to persevere with the work of reconstruction which had been in progress since the first year of the war. In erecting new plant, regard was had, as far as possible, to the requirements of peace as well as of war. But works had, above all, to be modeled in accordance with the pressing needs of the crisis;

and the thoroughness with which this was done is the measure of the problem which faced industry when the time came to return to normal production. The gearing of the industrial system again to its peace-time activities was found to be more formidable than had been generally anticipated.

Revival of Dead Industries—Narrowing of Output.

Owing to the strain upon transport through the enemy's submarine campaign, it became necessary to make an increasing number of things at home which hitherto had been supplied from abroad—largely from Germany, Austria, and Belgium in pre-war days, and more exclusively from America in later times. Various derelict industries were revived and some new ones were brought into being. Raw material and labor were turned to account to their utmost limits. Practically all went directly or indirectly to the service of the State. The volume of external trade was gradually narrowed until, in many of the representative products of this district, it was not more than half its shrunken dimensions of 1917, though the advance in prices somewhat masked the disparity. At home the remnants of stocks in shops and warehouses were used up. Then people simply did without things. Many trades handsomely increased their profits by realizing old stocks which had been out of date and written off long before. All sorts of articles of everyday use ceased to be made; or, if they were made at all, the ration of raw material for the civilian trade was so slender that the state of dearth was only modified a little. Pressure on shipping made it impossible for merchants to relieve the famine by importing, the prohibited list lengthening so rapidly that only vital things were omitted from it.

Special War Work of Birmingham District.

The resources of the Birmingham district were energetically concentrated on expediting the shipbuilding program, increasing the output of aircraft, and supplying the army with an overwhelming armament of tanks. Besides maintaining a constant stream of accessories—anchors, cables, tackle, fittings, and much miscellaneous equipment—to the shipyards, Birmingham and the Black Country undertook the production of hulls for standard ships, an enterprise which presented problems new to the district and which involved the installation of special plant. Between 30 and 40 constructional engineers joined hands under the guidance of the Admiralty. Each firm undertook that part of the work for which it was best qualified, and the plates, uprights, brackets, and other details were forwarded to the coast to be fitted together. The contracts were promptly canceled when the armistice brought peace in sight, much to the disappointment of the cooperating firms, who had hoped they were inaugurating a development which would be valuable after the war. Almost innumerable branches of the metal-working industries were mobilized for speeding up the production of aircraft. They proved invaluable auxiliaries of the great factories established in the district for the building of aeroplanes, and also supplied constructional details and equipment to factories in other parts of the country. As to the tanks, 80 per cent of Great Britain's total output came from the Metropolitan Carriage, Wagon & Finance Co.'s works at Oldbury, where vast shops, specially designed and organized for the purpose, turned out the monsters in series.

Costs and Prices in Iron and Steel Trade.

The freedom of the iron and steel trade was further encroached upon during the year by the exigencies of the military situation. Almost all the categories that had not already come under the control of the Ministry of Munitions were brought into line. Nominally, prices were limited to official maxima declared from time to time. In practice, however, a substantial amount of material changed hands at rates above those indicated by the authorities. Where the Government bought direct a good deal of play was given to the market, as no rough-and-ready classification could cover the almost endless varieties of material called for, particularly in the case of the wrought iron of Staffordshire output. On standard specifications there was more rigidity, but as far as private buyers were concerned disregard of the restrictions was often their only chance of getting supplies. It was significant that the producer seldom had for disposal the particular iron which the private employer wanted to buy at the maximum prices, but he could frequently manage to find a good substitute if the price was made sufficiently tempting. Still, the control secured the bulk of the output for Government purposes at prices proportioned to the cost of production and preserved the steadiness of the market in presence of factors that incessantly threatened its equilibrium.

The most unsettling feature was the rapid increase in the cost of coke and coal, due partly to the irresistible demands of the miners for higher wages and partly to concessions made to the coal owners on other grounds—grounds of expediency for the most part. General wage advances in which iron workers participated was another feature. So great did the production cost of iron and steel become that it was determined to balance the increment by subsidies rather than risk the market disturbance which must have resulted otherwise. The principle was that producers should be assured of a fair margin of profit, the national exchequer being drawn upon to offset the advancing cost of manufacture. Events marched at a pace which made strict correlation of costs and prices impossible, even if the calculation had not been complicated by the varying conditions of individual producing units. But the net result was to stabilize the market without leaving any very solid grounds for complaint that traders were being treated illiberally.

It was inevitable that the artificial restraints put upon the market should breed many anomalies and occasional hardships. Still, the overmastering necessities of the situation were widely recognized, and responsible criticism was reserved chiefly for the failure of the system to properly take account of the interests of the market.

Difficulties of Price Adjustment—Scarcity of Foundry Pig.

It was difficult to say what the actual position was at any given time with regard to questions of control and price adjustment in which the market had a stake. It therefore became a settled practice to make all business conditional on the edict of the Ministry of Munitions. Sellers attached a special note to contracts, reserving the right to add to the price any increase notified before completion. As long as war conditions lasted this had no further effect than to complicate the bookkeeping, but subsequently the impossibility of having definite prices prejudiced the work of reconstruction

The measures taken to turn more furnaces onto basic pig, brought about severe stringency in both foundry and forge pig iron. Smelters strove to improve their production, but circumstances were too powerful for them. They were handicapped by transport deficiencies, by the weakening of the available labor supply, by the inferiority of much of the coke and native ore to which recourse was had to economize shipping. The stringency endured as long as the war was prosecuted. Industrial rationing of coal was ultimately applied as far as circumstances allowed.

Wrought-Iron Industry Hampered by Lack of Puddlers.

By midsummer the effect of the resolute efforts made to increase the output of steel had begun to be apparent in the slackening of the market tension and anxiety centered rather on the wrought-iron trade, of which Staffordshire is the principal seat. There are 600 to 700 puddling furnaces in the district, all operated by hand. They have a total capacity of over half a million tons of puddled bar per annum, and used to employ 10,000 men. Trouble had been experienced in manning them for a number of years past. This was accentuated by the rush of men to the colors at the outbreak of war and by the unfortunate delay in stopping the outflow of puddlers, who could not be replaced. Experiments in mechanical puddling had not been viewed with much favor and the result achieved did nothing to overcome the prejudice entertained against it. Impressed with the seriousness of the position, the Staffordshire Ironmasters Association began a protracted trial of a new system of mechanical puddling at a specially constructed experimental furnace in North Staffordshire. The trial was in progress throughout 1918. Meanwhile, no measures were taken to extend the commercial use of the invention, though the dearth of puddled iron became increasingly acute. During the year, the necessity of bringing puddled bars under control was realized, and they became subject to the regulations as to prices, allocation, etc., applying to other classes of material which the Ministry took directly under its charge.

Steel Prices Firm After Armistice.

The system of control effectually prevented any serious reaction in the iron and steel market when the armistice was concluded. There was little danger of a collapse of prices, since the cost of production was much more than the consumer was being charged. However, the requirements of the situation were still in excess of productive capacity in many directions. This was conspicuously true of iron and certain classes of steel. The imperative necessity of making good the destruction of shipping of itself kept a strong trade current running. In those departments which depended upon active fighting, contracts were broken gradually so as to ease the transition to peace conditions. A timely announcement as to the transfer of the subsidies to export sales, and subsequently by successive stages to the home consumer, likewise had a steadying influence.

Prices and Output of Steel Shapes, etc.

In the table below are summarized the particulars of output and average net selling prices of 1918, as published in the bimonthly returns of the Midland Iron and Steel Wages Board, together with the

corresponding figures for the four years preceding—the statistics thus covering the period of the war. They are useful for comparative purposes, but have no relation to the total production, being extracted from the books of 17 representative firms whose records regulate wages under a sliding scale based on selling prices. The area of the wages board included North and South Staffordshire, Shropshire and parts of Lancashire, South Yorkshire, Cheshire, Derbyshire and North and South Wales. Bars, angles and tees, plates and sheets, hoops, strips, and miscellaneous material are the categories covered by the returns, which are given as follows:

Year.	Bimonthly periods.					
	January–February.	March–April.	May–June.	July–August.	September–October.	November–December.
OUTPUT.	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*
1914	32,881	28,101	28,831	28,828	30,989	28,077
1915	30,553	35,332	31,291	30,554	30,322	30,532
1916	30,333	31,766	33,644	28,940	32,235	31,617
1917	28,758	30,961	32,530	30,037	31,504	31,034
1918	31,260	30,549	27,578	23,739	27,290	22,109
SELLING PRICE.						
1914	$35.24	$34.28	$33.03	$33.16	$35.52	$36.03
1915	36.20	38.08	41.55	46.50	50.77	54.58
1916	59.35	63.48	66.65	68.66	70.20	71.45
1917	73.15	74.19	74.45	74.39	74.73	75.42
1918	75.98	76.30	76.69	78.02	80.19	80.66

The statistics of output afford striking evidence of the effect upon production of the withdrawal of men from the coal, iron, and steel industries to meet the German onset in the spring of 1918. Later, fluctuations follow the course of influenza epidemics. Prices continued to appreciate, as they had done with only one slight check from the beginning of the war. Staffordshire marked bars advanced during the year from £15 10s. to £17 (from $75.43 to $82.73). These figures established a new record, the previous highest price being £16 ($77.88) in 1872, following the Franco-German war. Moreover, business at the year's end was being done at net terms, f. o. t. (free on truck) makers' works, whereas a discount of 2 per cent was allowed formerly and the quotation included freights.

Advances in Wages in Iron and Steel Industry—Labor Dilution.

Puddlers' wages advanced during the year under the Midland sliding scale from 18s. ($4.37) per ton to 19s. 9d. ($4.80) per ton, an allowance being included to offset the Government subsidy so as to neutralize its effect in keeping down the average selling price. Forge and mill men received corresponding advances.

Tendencies which the preceding three war years had been inducing in the engineering trades gave new aspects to the industry in 1918. The process known as labor dilution was carried to its ultimate stage. Skilled workers, their ranks thinned by recruitment for military service, had cast on them the heavy responsibility of maintaining the efficiency of plants operated by hurriedly trained volunteers, including swarms of women and girls whose qualifications at best extended little farther than a certain familiarity with simple repetition work on machines. The critical position of the Allied Armies eventually necessitated the desperate step of withdrawing the youths

from the engineering shops as they became eligible for military service.

Other Difficulties.

During the three years that had gone before, engineers had provided themselves with mechanical equipment for performing a great deal of work that had hitherto been done by hand. The development of labor-saving machinery increased through 1918. Machine tool shops at home were kept going at high pressure, though they, too, had to submit to the ordinance which demanded men to fill the gaps in the fighting ranks. A great deal of the most virile labor was withdrawn, and women occupied the vacancies. Works managers testified to the good service which the women rendered, but those who were able to advance into the more skilled jobs were comparatively few. The machine-tool trade was, therefore, placed at a serious disadvantage and its troubles were aggravated by the migration of numbers of its experienced mechanics into the great munitions establishments, where they could get much higher wages. Inevitably the output of machine tools shrank notably. Supplies were augmented by large importations from America: but there again the difficulties of shipping added to the anxieties of the situation. Freight room was difficult to obtain. Some valuable consignments were sunk. On the whole, however, the vitalizing inflow of new machinery was marvelously maintained. The stringent measures taken to control distribution insured that no part of these sorely needed resources went to unessential purposes.

How Machine-Tool Industry Met War Demands.

At the most critical phase of the struggle all available energy was concentrated on the mobilization of machine tools and engineering accessories for special production schemes, particularly in connection with aircraft and marine work. The ingenuity of the machinist was also taxed to provide ready means of manufacturing a great variety of new implements of warfare devised to meet military exigencies. Specializing as they do in smaller types of tools, the machine-tool experts of the Midlands were in a position to render valuable help in this direction. But the circumstances of the time left no opportunity for experimenting with novelties if standard tools would do. Hence, the trade as a whole did not diverge from the beaten track. It was not a period of development. Individual forms were kept at the restricted range of models and sizes on which they had been required to reorganize; and in this way the maximum results were got out of the depleted stock of labor. Little attempt was made to elaborate automatic tools or multiple-purpose machines. The simplest and most easily adjusted tools, designed for single operations, were found most serviceable. These could be worked with the minimum of skill and experience, they were made "foolproof" as far as possible, and one skilled man sufficed to keep many of them in good running order for the dilutees to operate.

Effects of War Adjustments on Machine-Tool Trade.

Broadly, the year's work gave to the machine-tool section a keener consciousness of its potentialities. It was occupied very largely in supplying the needs of the industrial area immediately about it—a very considerable field, since something like a million hands were en-

gaged in engineering branches in the district when the output of munitions was at its zenith. A heavy strain fell upon the manufacturers of presses, who further extended their productive capacity and also developed in the direction of higher power. Grinding machines were increasingly employed in place of turning, filing, and lapping, a great impetus being given to the home production, which was already disputing the American ascendency when the war began. The demand for tool-room equipment was increasing. It manifested itself in applications for American lathes and other adjuncts which the supply never overtook. One effect of the war was to awaken a much livelier appreciation of the importance of an efficiently organized tool room as a feature of every engineering establishment.

The increased production of small tools and accessories also made this industry more independent. It was not possible to get along, however, without importing many specially designed tools, such as involuted cutters, for fitting to American machines. American twist drills maintained their supremacy. War developments have been accompanied by a notable advance in high-speed tools. The research work has prepared the way for important modifications of engineering specifications, particularly in the design of engines and running parts of machinery. Furnace practice has made great strides, the most pregnant development having reference to the hardening of steel.

Increase of Electric Power Available for Industry.

Electrical engineering steadily consolidated its position in the district. The industrial versatility of Birmingham and its neighboring towns has been an important contributory factor. Owing to limitations imposed on the supply of current, the movement toward further electrification of industry was temporarily arrested. The great munitions establishments made such continuous demands on the available current that, although the horsepower supplied in Birmingham in 1918 was nearly double the amount being supplied when the war began, the requirements of a large number of manufacturers could not be complied with owing to the urgency of demand. Facilities were at length afforded by the Government for supplementing the existing generating plant and extensions which had been held up for several years were put in hand. These will give Birmingham an additional supply of 30,000 kilowatts with means of greatly increasing the output as necessity arises.

Cooperation in Production in Engineering Trades.

There has been a significant advance in the production of various engineering accessories, notably of soluble cutting lubricants, local manufacturers cooperating in a forward policy which will make British engineers in this respect independent of the German sources to which they formerly looked for most of their supplies.

On the business side, arrangements were completed for interdependent working of groups of engineering firms in various parts of the country, along the lines of specialized production initiated by the necessities of the war. The principles which govern these combinations are the avoidance of overlapping and wasteful competition, stricter concentration to secure the advantages of bulk production, and cooperative efforts toward the cultivation of the export trade.

The individual firms remain separate units. Some engineering concerns have permanently reduced the diversity of their products by 90 per cent. Still, as regards many important details of practice, standardization remains no more than an ideal.

Brass Industry—Practice Introduced of Pressing From Billet.

The brass industry, of which Birmingham is the principal center, was pretty fully occupied during the year, though the dwindling labor supply and the tight hold that was maintained over raw material made it increasingly difficult for some of the factories to be kept going. Improved organization had so greatly expedited the output from the better equipped establishments as to render a certain number of the others superfluous as far as war work was concerned.

On the other hand, the exigencies of military requirements brought into the brass trade a few manufacturers whose previous experience had been in other directions, but who possessed the plant required for munitions in hot stampings and pressings. The work of these plants is likely to leave a permanent impression upon the industry. It was only under the stress of the war that the British brass trade attempted to exploit the possibilities of pressing from the billet, though Germany had been sending into their market a considerable range of products made in this way at prices which compared very favorably with anything quoted by home producers who pinned their faith to the older process of casting.

Some of the powerful presses in the Birmingham electroplating factories were turned onto brass products when the demand for fuse bodies and shell parts of all sorts began to exceed the capacity of the existing brass trade; and thereafter the pressing of a great variety of parts advanced so rapidly that at the signing of the armistice the process had become well grounded. Firms that gave themselves to this work as an emergency measure became deeply impressed with its potentialities and will certainly seek to put their experience to practical account in the era of peace. In fact, they lost no time in preparing to enter the market, and had already a large demand in sight before the close of the year. It is believed that press work may be advantageously applied to railway carriage and automobile fittings and fittings for a large variety of cabinet furniture which was formerly produced by casting or machined from the solid bar.

Progress in Machine Molding.

Machine molding made some progress in the Birmingham brass industry, but continued to be looked upon rather jealously by the trade union. In other directions, machinery was increasingly substituted for older methods. Capstan lathes were installed and practice was modified in various ways to overcome the dearth of casters. Incidentally, these new departures proved that in a great many instances new methods could be pursued with a gain in cheapness and efficiency. There was accordingly an emphatic demand at the end of the war for a thorough overhauling of the industry in the light of all the new factors which had emerged out of the arrangements improvised for supplying munitions.

Growth of Foreign Competition in Brass Industry.

Although Birmingham still represented something like two-thirds of the total output of brass in the Kingdom, it was felt to be losing

ground in certain directions to younger rivals both at home and abroad. Its rolling mills were sending an increasing proportion of their output to other centers to be worked up. The local tendency was to concentrate on those branches of the industry which were directly complementary to neighboring manufactories. Naval work, a great deal of boiler work, munitions, and plumbers' heavy castings had gradually left Birmingham, having been neglected in order that manufacturers might be freer to specialize in the multiplicity of light specialties.

In the comprehensive proposals that were made toward the end of the year for a reconstruction of the industry, the intensified competition with which British manufacturers saw themselves threatened was an influential factor. While they had been preoccupied with munitions, Japan had been industriously replacing their exports in various foreign markets and in British possessions as well. The initiative, skill, and cheap labor of the Japanese was felt to be a serious menace. American competition was also feared, and there was another impelling force in the probability of Germany's again taking the British trade at disadvantage unless the problems of cheapening production and cutting out wasteful internal competition were solved.

The valuable Australian market had been isolated to a great extent from the British manufacturers; and meanwhile the Commonwealth had been developing its self-supporting policy which, it was inferred, would mean a permanent displacement of trade. South America, too, had been moving in the same direction. It was realized, therefore, that a livelier enterprise, coupled with more scientific costing and management, would have to be injected into the British trade if it was to find outlets for the larger production of which it had become capable during the war. In the details of reconstruction, specialization and standardization were given a prominent place. Individual manufacturers determined to confine themselves to smaller spheres in which they could produce in quantity and the multitudinous patterns in their catalogues were drastically reduced. But schemes for a coordination of the trade as a national unit had not advanced beyond the academic stage when the year closed, the uncertainty of the labor position delaying decisions.

Aluminum and Other Metal-Working Trades.

In other metal-working industries, the civilian trade was kept alive by the system of rationing raw material. Generally speaking, about one-fourth of the output was applicable to this purpose, though a 25 per cent allocation was more than could be afforded in the case of certain metals. For example, aluminum was not obtainable until toward the end of the year for other than war purposes, and then only in small quantities. This had the effect of postponing expansion in the aluminum hollow-ware trade, in which Birmingham was preparing to take a much bigger hand.

Conditions in the Hardware Trade.

American enterprise had done so much to replace German and Austrian supplies in the British market that the hardware trade was kept going in some degree of vitality throughout the year. Nevertheless it declined perceptibly. The output at home was neces-

sarily squeezed down to the minimum and supplies from America were so closely restricted that Britain knew the want of many such things as household utensils, builders' hardware, and hand tools. Housewives had to learn to do without kettles if they could not get their derelicts patched. The same applied to other cooking utensils. Stoves and similar domestic appliances were not to be had. As to gas and electric fittings, stocks were down to skeleton proportions. Such building accessories as were available were appropriated to extensions of munitions establishments or other uses incidental to the war. Stocks in the hands of retailers shrank to very small proportions, and the rationing of ironmongery was contemplated in the interests of an equitable distribution. But the practical difficulties of such a plan were very great, and, instead, the responsibility of preserving an even balance between different districts and competing interests was accepted as an honorable obligation by the big merchant houses handling this line. These houses contrived to make available resources go a long way, and at the close of the year they had reserves of stock for the 1919 trade.

The advance which hardware factors had made in the matter of mechanical equipment during the earlier years of the war was an important offset to the partial paralysis which came upon them before the end. On balance, therefore, the position was considered distinctly hopeful at the close of the year. The growing difficulty of getting supplies through from America had enforced an extension of home production in various essentials such as wire goods, nails, etc. Plans were also laid for extending the manufacture of safety razors and many small wares.

Reconstitution of Automobile Industry.

The big automobile firms had turned over their plants entirely to war work, but they did not wait for the armistice before organizing their future trade. By the end of November one of the largest of these firms had booked business to the value of nearly £4,000,000 in various parts of the world, but chiefly in the East. Three months later, the booking represented nearly £6,000,000. This is a sample of what wide-awake firms were doing to secure the markets for the greatly increased production to which they were practically committed by war-time developments. As soon as it became evident that the fighting was over, they discarded all the special shell-making equipment and other extraneous features and began transforming their factories for bulk production of standardized parts to be assembled and finished in the ultimate stage. One firm, which has mechanical resources and floor space for the employment of about 15,000 hands, with ready facilities for further expansion, will concentrate on three designs of touring cars and a general utility lorry, all adapted to a single type of chassis. They will also make an agricultural tractor and do some subsidiary manufacturing. Another company, which has an ultimate capacity of about 20,000 cars per annum, is confining its program to one carriage, one open touring car, and one runabout, with specialized production of parts; the single type of chassis is not favored here.

The salient feature in the reconstruction of the automobile industry is simplification of design with as few departures from uniform-

ity as possible. The extent to which leading firms are giving effect to those principles will make the industry very different from that of pre-war times. Difficulties experienced in getting acceptable quotations for components and accessories manufactured outside the automobile works, as well as shortage of key men and the inflated price of building materials, have embarrassed the reconstruction. The reluctance of producers to quote firm prices, in view of the uncertainty which has prevailed as to costs, also placed automobile makers in a quandary when it came to fixing the price of their cars. The big makers realized, however, that the market would not be open to indefinite bargaining, and issued their catalogues with fixed prices.

Cycle and Allied Trades.

No development was possible in the cycle manufacturing industry until after the armistice. Apart from the production of military machines, there was little material, labor, or plant left at the disposal of the trade. Some of the smaller manufacturers were forced to make important changes in workshop economy in order to get munitions contracts to keep them going; so that a new bias was given to the operations which is likely to have permanent effects. Despite the restriction put upon the trade, a small output of cycles was maintained and these could have been sold many times over. Increasing difficulties of getting about, due to curtailment of train, bus, and tram services and the restrictions on automobile traffic, caused many people to turn to the cycle as a valuable means of locomotion. Stocks of components were used up, and there were many ingenious improvisations to meet the emergency. Though supply fell far short of demand, it reached proportions which spoke well for the resourcefulness of the trade. The capacity of the trade for exporting components directly the war was over was considerably ahead of the freight and other facilities allowed.

Although the industry was largely diverted to war equipment, it had already greatly extended its potential strength before the pressure became so compelling, particularly in developing branches of manufacture—such as spokes and ball bearings—in which it had previously relied upon foreign sources of supply. In addition, a great many of the machine tools which had been installed for war work were capable of adaptation to the manufacture of cycle parts, albeit the task of conversion and reorganization was obviously a formidable one. It was estimated that the pre-war output amounted to about half a million complete machines per annum, most of them being made in this district. At the close of the war one Birmingham firm claimed to be in a position to make 5,000 per week, and its reconstruction plans were primarily shaped in this direction. There was a movement toward standardization of certain parts, but the problem was approached very cautiously. The chief asset of the years of war, from the viewpoint of the cycle engineers, was the stimulus given to the construction of engines for motor cycles.

Automobile and cycle lamps, which are made principally in Birmingham, assumed an increased economic importance, successful efforts being made to replace the glass which was formerly imported from Austria, Germany, and elsewhere. Lamp lenses had to be obtained from America in very large part, however.

Shortage of Railway Rolling Stock.

Nine-tenths of the resources of the railway wagon and carriage industry were devoted to a vast range of munitions, from shells to aeroplanes. War wastage had to be made good by sending immense quantities of rolling stock to France. How to get the best out of limited and rapidly diminishing resources was an anxious problem. The great car-building establishments of this district possessed unique resources for tank construction and other imperative needs of the war, and the margin of rolling-stock work was cut as fine as possible throughout the year. It followed that the end of the war brought tremendous arrears to be made up, and though development hung fire on the business side, the extremity was so obvious that firms lost no time in getting back to their normal lines. The salient tendency is toward steel construction in preference to timber; for, while timber must be brought overseas, builders have the steel at their own doors. In normal circumstances the rolling-stock firms get so little support from their home market, owing to the growing practice of the big railways to construct for their own account, that their ambitions are mainly centered on foreign fields. Accordingly, they are concerned about the extension of American financial interests in railway enterprise outside the United States. South America, South Africa, the Levant and Mesopotamia, India, and the European Continent are among the markets to which British rolling-stock manufacturers are looking for support.

Plans for Quantity Production in Sporting-Gun Trade.

The sporting-gun trade of Birmingham, already at a low ebb before the war, was reduced almost to a moribund condition. Its craftsmen left for other service, and though it devoted itself in a small way to war work, little was done to improve its material resources. It was realized that if the trade was to be saved an entire change of outlook, backed by drastic reorganization, would be necessary. When the armistice was concluded, work was begun toward enlisting all the sporting-gun firms in an enterprise to substitute quantity production along specialized lines for the individualistic methods of manufacture which had placed the trade at so great a disadvantage with America, Belgium, and Germany. Negotiations were proceeding when the year closed.

Large Demand for Jewelry—Plans for Increasing Export Trade.

Fairly regular supplies of gold were forthcoming for the Birmingham jewelry trade, despite the embargo on imports and the prohibition of the immemorial practice of melting down sovereigns. Silver was also obtainable under stabilized market conditions. The output of manufactured goods was limited by the transfer of plant and personnel to munitions, rather than by any straitened supply of raw material. Platinum, which had advanced into prime favor for gem setting, was appropriated for the points of magneto and other war work, and in these circumstances jewelers had recourse to palladium. Other changes included the installation of German machines for making chain and seamless tube, the higher development of the rolled-gold branch, production of watch cases, and some extension of gem cutting. Antwerp diamond cutters were employed in the jewelry quarter and a start was made toward training discharged sol-

diers for work on soft gems. The demand for all classes of jewelry was always ahead of supply, and old stocks were cleaned out. During the year, Birmingham jewelers combined with fellow traders in London and Sheffield to send an imposing array of samples of their wares to South America in charge of an agent appointed by the Board of Trade for the purpose of opening new avenues of business.

Increased Production of Glass—Development of Optical Glass Manufactures.

Under the exigencies of war pressure there were notable developments in several branches of the glass industry. The Birmingham and Stourbridge districts, which are the chief centers of the flint-glass trade, increased their productive capacity in response to an urgent demand for electric lighting bulbs, lamp chimneys, and other lighting accessories. Means were likewise taken to extend greatly the manufacture of rod. Further progress was made with the establishment of the medical and laboratory glass section. Shortage of potash made it necessary to employ chemical substitutes for ordinary manufactures, but by recovering potash from blast-furnace dust supplies were made available for an important expansion of optical glass manufactures, such as employed in photographic lenses, range finders, etc. This work was developed at the instance of the Government.

During the year women workers who had been trained as glass cutters by virtue of the suspension of the trade-union prohibition, made good in that department of activity. There was a ready acquiescence on the part of male operatives in the allocation of a considerable share of the simpler and less profitable glass cutting to female labor. In the civil trade, supplies of glass fell farther into arrears. Some manufacturers stated that they had orders for table glass and decorative glass for home consumption and export which would take six months to fill. The stringency was, of course, due to the abnormal pressure thrown on British glass manufacturers by the cutting off of the huge trade formerly done by Germany and Austria. Improvisations went some way toward broadening the base of the British manufacture, but it was never possible to make production commensurate with the increased demand.

Some of the special furnaces put in service for the production of optical glass were condemned to extinction after the armistice. The cinematograph industry is, however, expected to afford strong support to this branch. Manufacturers indulge no expectations of being able to compete with America in such products as lamp chimneys when normal conditions are restored. They also distrust their prospects with regard to electric lighting and other glass in which the enemy countries formerly specialized, unless they are accorded protection.

Leather Trade.

Saddlery and harness manufacturers find themselves with plants which have been magnified by war conditions to dimensions greater than peace requirements are likely to employ for a long time to come. The evolution from hand labor to machine processes has been rather marked in this industry. To it is due very largely the tenfold increase of productive capacity. Factories devoted to the manufacture of kit bags, valises, dress cases, attaché cases, and light

leather articles, were kept pretty busy during the year, but under increasing difficulties as regards raw material. The luxury as well as the utility side of the trade was maintained under the impetus of a strong demand. Efforts were made to occupy the field with cheap fancy goods, such as Germany used to produce unrivaled. Here, however, a determined opposition was encountered from Japan.

Insufficient Coal Output—New Mining Machinery Installed.

The fluctuations of the coal-mining industry were anxiously followed, both by the manufacturing interests dependent upon it and by the public at large. The working of the pits had been so seriously impaired by the withdrawal of men for the army that returns of output disclosed an ominous decline, which was seriously emphasized by epidemics of influenza and other untoward circumstances. Fuel supplies were not sufficient to keep the iron and steel industries in full operation, and a scheme for industrial rationing was introduced following restrictions of household supplies. The principle adopted was to allocate coal to particular industries and to individual manufacturers according to the value of the war work on which they were engaged. This helped to correct faults of distribution, but the shortage remained so acute, notwithstanding eleventh-hour measure to rush miners back from the army to the pit, that the situation was not sensibly relieved and remained critical until the termination of hostilities and after.

Here and there mechanical improvements were introduced in the operation of the industry. Pressure of events did not admit of their being applied on a scale sufficient to counteract the weakening of personnel, however. Some advance was made in the use of coal-cutting machines for thin seams. A partial electrification of the mines was acomplished; but a great deal of the hauling is done by pit ponies. In the Black Country many workings have been waterlogged. The South Staffordshire Mines Drainage Commission has fought the floods for a long time, but last year, owing partly to lack of fuel to drive the pumps and partly to the difficulty of maintaining the plant in efficiency, it was a losing fight.

The exploitation of native iron ores was carried further under war stress in various parts of the Midlands.

Manufacture of Magnetos—Casein Products.

Among new departures a great development was noticeable in the manufacture of magnetos. Past dependence on Germany for this vital adjunct called for diligent study of the problem by the scientists, whose research work was translated into practical terms by a group of manufacturers specializing in magneto production. Thus a promising industry has grown up in this district.

Another striking enterprise is the opening of a new field of manufactures from casein, which is collected from Ireland where dairying is organized on a larger scale than in other parts of the United Kingdom, and after treatment at a Stroud factory is sold to manufacturers in sheets and rods. In the preliminary treatment various colors are introduced, and the finished product assumes a wide range of uses, including electrical insulation (particularly for aeroplanes), carriage fittings, artificial limbs, knife handles, etc., besides serving for a variety of small fancy articles from buttons to picture frames. Goods made from casein were previously imported from Germany.

Advance in Agriculture—Land Armies of Women and Children.

A deeper appreciation of agriculture as a national bulwark is evident. The work of breaking up grass land for wheat sowing continued during a great part of the year. In addition to the American tractors which were imported to aid in the work, British engineers were able to put a number of newly designed mechanically operated implements at the disposal of farmers, who were nevertheless unequal to the complete accomplishment of the task set them. Labor had to be specially trained for the utilization of this new plant, and the organization of women land workers proved a valuable resource. The ranks of the women helpers were recruited from all the social strata. Rural dwellers, many of whom had a working acquaintance with husbandry, mobilized for the emergency. Large numbers of women and girls belonging to the well-to-do classes in the towns, as well as those to whom wage earning was a necessity, enrolled themselves in the different organizations formed under semiofficial auspices for giving effect to the land program. A distinctive garb was adopted in some cases, but not in all. Breeches and smocks, leggings and hob-nail boots largely approved themselves. School children were also set to work on the land in organized gangs.

School children were also set to work on the land in organized gangs. The great public schools altered their hours of work and schemes of instruction so as to set the boys free for the service of the farmers. Prisoners of war and soldiers were likewise employed to tide over the crisis. But with all these expedients, the withdrawal of skilled labor for military service at a time when the land was being called upon to yield its increase in greatly intensified degree, was severely felt. Though the full effects were not immediately apparent, the disturbance of the natural succession of crops, the shortage of fertilizers, the forced slaughter of stock, and the general unbalancing of the economic factors in British farming, opened up a train of consequences which will have to be faced.

The convulsion resulted in bringing abstract and applied science to the reinforcement of agricultural practice to an extent hitherto unknown. With high prices insured, the farming class throve under the rigid controls established over their buying and selling and day-to-day avocations. While tractors were chiefly hired, either from the public authorities or from private owners, farmers invested considerable capital in improving their equipment.

Declared Exports to United States.

The total value of the exports from Birmingham to the United States increased from $3,617,307 in 1917 to $3,861,069 in 1918. Chain cables constituted the most important item invoiced, the total value of these exports being $1,190,470, an increase of $807,806 over 1917. These chains, the manufacture of which is a highly specialized industry of the district, were all intended for the ships being built by the Emergency Fleet Corporation. The next largest item exported was that of needles, which showed a total value of $894,302, an increase of $609,433 over the previous year. The Redditch needle manufacturers were able to supply only a small portion of needles called for by American importers, because of lack of raw material and the shortage of labor.

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Below are give the values of the principal articles declared at the consulate at Birmingham for shipment to the United States in 1917 and 1918:

Articles.	1917	1918
Agricultural implements	$23,937	$53,996
Animals: Dogs	4,511	.....
Art, works of	11,401	3,236
Automobile parts	4,498	.....
Bicycle parts	19,542	.....
Motor-cycle parts	6,138	.....
Books, printed	5,681	4,549
Bort	.....	1,390
Brass manufactures, n. e. s.	34,181	29,620
Brushes	9,139	1,782
Buttons, of horn, metal, etc.	27,352	9,324
Carpets	49,867	.....
Chalk, precipitated	22,262	22,579
Chemicals:		
Ammonia, carbonate	17,369	1,328
Ammonia, muriate	19,136	6,029
Sulphur, crude	.....	128
Sulphur, lac	702	1,095
Soda, bicarbonate	1,237	643
All other	4,208	.....
Cotton manufactures:		
Bandings	21,270	14,384
Labels for garments	7,725	4,934
Laces, insertings	2,940	4,890
Yarn, bleached	10,101	10,090
All other, n. e. s.	10,150	7,772
Cutlery	525	294
Diamond dust	22,439	18,875
Earthenware:		
Decorated	57,083	46,476
Not decorated	404	688
Tiles, plain, unglazed	1,380	418
All other, n. e. s.	6,775	2,683
Fibers, manufactures of:		
Cord, n. e. s.	2,724	153
Printed linens, n. e. s.	2,888	2,993
Fish hooks and fishing tackle	53,878	110,718
Flax, manufactures of	3,761	717
Fur skins, rabbit	333,928	294,091
Gelatin	15,583	.....
Glass manufactures:		
Plates, unwrought, for spectacles	176,313	245,846
Glassware, articles	76,120	43,336
Stained-glass windows	2,575	10,185
All other	39,404	36,641
Gloves:		
Men's sheepskin, unlined	36,786	16,854
Women's sheepskin	29,668	17,633
All other	5,281	5,138
Glue	1,708	.....
Hides and skins: Sheepskins, pickled	15,883	.....
Horsehair manufactures	2,851	.....
India-rubber manufactures	90,431	74,444
Iridium	12,461	6,879
Iron and steel manufactures:		
Anchors	2,850	8,999
Iron and steel manufactures—Continued.		
Chain—		
Sprocket	$18,404	$1,184
Other	382,664	1,190,470
Machinery parts	5,285	2,247
Sashes, frames, etc.	55,930	7,731
Sheets, tinned	4,718	.....
Wire staples	21,726	.....
All other	61,753	17,213
Jet manufactures	2,352	250
Jewels for watches and meters	12,360	7,292
Lead manufactures	19,449	772
Leather	18,925	.....
Leather manufactures:		
Bags—		
Unfitted	67,076	46,254
Fitted	5,520	4,322
Harness and saddlery	43,454	26,576
All other	23,833	19,150
Metal manufactures, n. e. s.	55,986	51,096
Needles:		
Needle cases	6,028	.....
Hand sewing	240,876	780,792
All other	37,965	113,510
Paints and varnishes:		
Chrome yellow	642	.....
Indian reds, oxides	19,012	7,626
Varnish, spirit over 10 per cent	5,225	207
All other	9,555	1,597
Paper manufactures:		
Transfer paper	5,770	.....
Other	8,524	4,158
Pens and penholders:		
Pens, metallic, n. e. s.	141,672	162,534
With nib and barrel	2,820	3,530
Penholders and tips	524	516
Photographic film	4,830	2,691
Pins, base metal	75,171	59,416
Precious stones:		
Diamonds	.....	661
Pearls	23,537	10,237
All other	12,769	8,209
Sauces and pickles	51,381	14,998
Silk:		
Artificial, yarn	764,567	155,752
Manufactures	3,589	5,162
Silver and silver-plated ware	12,717	6,221
Soap:		
Toilet, perfumed	8,715	499
All other	9,980	892
Tin manufactures, n. e. s.	3,539	1,122
Toys, n. e. s.	9,795	1,277
Vinegar	10,519	80
Wood manufactures	10,762	7,144
Wool manufactures	2,620	1,121
All other articles	27,724	11,724
Total	3,617,307	3,861,069

Exports to Porto Rico amounted to $24,700, as compared with $6,661, in 1917, the increase being due to the large shipments of agricultural implements (amounting to $20,084), and iron and steel manufactures (amounting to $3,432). The exports to the Philippines, which in 1917 were valued at only $9,347, increased to $66,350 in the year under review. Of this total, $57,017 consisted in diamonds and pearls. The value of the shipments to the Virgin Islands was $6,317. There were no shipments whatever from this district to Hawaii. Returned American goods amounted to only $2,101, as compared with $8,058 in 1917.

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